CLAIMS

1. An optical coherence tomography (OCT) system comprising:

an interferometer having a reference arm and a sample arm each having an optical path, the sample arm being disposed such that a test sample reflects a sample portion R_S of an incident optical signal S_S along the sample arm optical path;

a reflector disposed in the reference arm to reflect a reference portion R_R of an incident optical signal S_R along the reference arm optical path;

a source for producing an optical source signal S having a short coherence length and a first polarization state;

a polarizing beam splitter disposed to direct portions of the optical source signal S along the reference arm optical path and the sample arm optical path;

a first polarizing element disposed to select, from the returning reference and sample portions (R_R+R_S), a detector component S_D having a second polarization state; and

a detector disposed to produce an output signal V_D representing the optical signal intensity I_D of the detector component S_D, wherein the second polarization state is related to the first polarization state such that the detector operates in a noise-optimized regime.

2. The OCT system of claim 1 further comprising:

a first filter coupled to the detector for separating, from the output signal V_D, a low-frequency component V_L representing a scanning laser ophthalmoscope-like (SLO-like) image pixel;

first data storage means for storing a plurality of pixels $\{V_H\}$ representing a two-dimensional (2D) OCT *en face* image;

second data storage means for storing a plurality of pixels $\{V_L\}$ representing a 2D SLO-like image; and

processing means for removing motion artifacts from 2D OCT *en face* image data in accordance with the corresponding SLO-like image data.

3. The OCT system of claim 2 further comprising:

a scanner disposed to sweep the incident optical signal S_S over at least part of the test sample;

and a reflector motor disposed to move the reflector along the reference arm optical path.

4. The OCT system of claim 2 wherein the interferometer is a Michelson interferometer.

5. The OCT system of claim 2 further comprising:
a second polarizing element disposed in the sample arm optical path such that the returning sample portion R_S is directed by the polarizing beam splitter to the detector

6. The OCT system of claim 2 further comprising:
in the processing means, rendering means for realigning the pixel data representing a 2D OCT *en face* image with respect to the pixel data representing another 2D OCT *en face* image.

7. The OCT system of claim 2 further comprising:
an attenuating element disposed in the reference arm optical path to attenuate optical signals therein.

8. The OCT system of claim 2 further comprising:
a second filter coupled to the detector for separating, from the output signal V_D, a high-frequency component V_H representing an OCT image pixel.

9. The OCT system of claim 1 further comprising:
a scanner disposed to sweep the incident optical signal S_S over at least part of the test sample; and
a reflector motor disposed to move the reflector along the reference arm optical path.

10. The OCT system of claim 1 wherein the interferometer is a Michelson interferometer.

11. The OCT system of claim 1 wherein the interferometer is a Mach-Zehnder interferometer.

12. The OCT system of claim 1 further comprising:

a second polarizing element disposed in the sample arm optical path such that the returning sample portion R_S is directed by the polarizing beam splitter to the detector

13. The OCT system of claim 1 further comprising:

a second polarizing element disposed in the reference arm optical path such that the returning reference portion R_R is directed by the polarizing beam splitter to the detector.

14. The OCT system of claim 1 further comprising:

in the detector, a plurality of optical transducers each disposed to produce an electrical signal responsive to the detector component S_D.

15. The OCT system of claim 1 wherein the second polarization state is related to the first polarization state such that the detector operates in a shot-noise limited regime.

16. An optical coherence tomography (OCT) system comprising:

an interferometer having a reference arm and a sample arm each having an optical path, the sample arm being disposed such that a test sample reflects a sample portion R_S of an incident optical signal S_S along the sample arm optical path;

a reflector disposed in the reference arm to reflect a reference portion R_R of an incident optical signal S_R along the reference arm optical path;

an optical source for producing an optical source signal S having a short coherence length;

a beam splitter disposed in the interferometer to direct portions of the optical source signal S along the reference arm optical path and the sample arm optical path;

a detector disposed to produce an output signal V_D representing the optical signal intensity I_D of the returning reference and sample portions (R_R+R_S);

a first filter coupled to the detector for separating, from the output signal V_D, a low-frequency component V_L representing a scanning laser ophthalmoscope-like (SLO-like) image pixel;

first data storage means for storing a plurality of pixels $\{V_H\}$ representing a two-dimensional (2D) OCT *en face* image;

second data storage means for storing a plurality of pixels $\{V_L\}$ representing a 2D SLO-like image; and

processing means for removing motion artifacts from 2D OCT *en face* image data in accordance with the corresponding SLO-like image data.

17. The OCT system of claim 16 further comprising:

a scanner disposed to sweep the incident optical signal S_S over at least part of the test sample; and

a reflector motor disposed to move the reflector along the reference arm optical path.

18. The OCT system of claim 16 further comprising:

an attenuating element disposed in the reference arm optical path to attenuate optical signals therein.

19. The OCT system of claim 16 further comprising:

a second filter coupled to the detector for separating, from the output signal V_D, a high-frequency component V_H representing an OCT image pixel.

20. The OCT system of claim 16 further comprising:

in the processing means, rendering means for realigning the pixel data representing a 2D OCT *en face* image with respect to the pixel data representing another 2D OCT *en face* image.

21. In an optical coherence tomography (OCT) system including a detector having a plurality of noise-limited operating regimes and an interferometer having a reference arm and a sample arm each having an optical path, the sample arm being disposed such that a test sample reflects a sample portion R_S of an incident optical signal S_S along the sample arm optical path, a machine-implemented method for rendering a three-dimensional (3D) image of a test sample comprising the unordered steps of:

(a) producing an optical source signal S having a short coherence length and a first polarization state;

(b) directing a first portion S_R of the optical source signal S along a reference arm optical path and directing a second portion S_S of the optical source signal S along a sample arm optical path;

(c) reflecting a reference portion R_R of the first portion S_R along the reference arm optical path;

(d) selecting, from the returning reference and sample portions (R_R+R_S), a detector component S_D having a second polarization state; and

(e) producing an output signal V_D representing the optical signal intensity I_D of the detector component S_D, wherein the second polarization state is related to the first polarization state such that the detector operates in a noise-optimized regime.

22. The method of claim 21 further comprising the steps of:

(f) separating, from the output signal V_D, a low-frequency component V_L representing a scanning laser ophthalmoscope-like (SLO-like) image pixel and a high-frequency component V_H representing an OCT image pixel;

(g) storing at least one value V_H representing a two-dimensional (2D) OCT *en face* image pixel;

(h) removing a motion artifact from 2D OCT *en face* image data in accordance with the corresponding SLO-like image data.

23. The method of claim 22 further comprising the step of:

(g.1) storing at least one detector output component V_L representing a 2D SLO-like image pixel.

24. The method of claim 22 further comprising the step of:

(h.1) realigning the pixel data representing a 2D OCT *en face* image with respect to the pixel data representing another 2D OCT *en face* image.

25. The method of claim 21 further comprising the steps of:

(b.1) sweeping the second portion S_S over at least part of the test sample; and

(c.1) moving the reflector along the reference arm optical path.

26. In an optical coherence tomography (OCT) system including a detector having a plurality of noise-limited operating regimes and an interferometer having a reference arm and a sample arm each having an optical path, the sample arm being disposed such that a test sample reflects a sample portion R_S of an incident optical signal S_S along the sample arm optical path, a machine-implemented method for rendering a three-dimensional (3D) image of a test sample comprising the unordered steps of:

(a) producing an optical source signal S having a short coherence length;

(b) directing a first portion S_R of the optical source signal S along a reference arm optical path and directing a second portion S_S of the optical source signal S along a sample arm optical path;

(c) reflecting a reference portion R_R of the first portion S_R along the reference arm optical path;

(d) selecting, from the returning reference and sample portions (R_R+R_S), a detector component S_D;

(e) producing an output signal V_D representing the optical signal intensity I_D of the detector component S_D;

(f) separating, from the output signal V_D, a low-frequency component V_L representing a scanning laser ophthalmoscope-like (SLO-like) image pixel and a high-frequency component V_H representing an OCT image pixel;

(g) storing at least one value V_H representing a two-dimensional (2D) OCT *en face* image pixel; and

(h) removing a motion artifact from 2D OCT *en face* image data in accordance with the corresponding SLO-like image data.

27. The method of claim 26 further comprising the step of:

(g.1) storing at least one detector output component V_L representing a 2D SLO-like image pixel.

28. The method of claim 26 further comprising the step of:

(h.1) realigning the pixel data representing a 2D OCT *en face* image with respect to the

pixel data representing another 2D OCT *en face* image.

29. The method of claim 26 further comprising the steps of:

(b.1) sweeping the second portion S_S over at least part of the test sample; and

(c.1) moving the reflector along the reference arm optical path.

30. A computer program product for use in an optical coherence tomography (OCT) system including an interferometer having a reference arm and a sample arm each having an optical path, the sample arm being disposed such that a test sample reflects a sample portion R_S of an incident optical signal S_S along the sample arm optical path, a reflector disposed in the reference arm to reflect a reference portion R_R of an incident optical signal S_R along the reference arm optical path, an optical source for producing an optical source signal S having a short coherence length, a beam splitter disposed in the interferometer to direct the optical source signal S along the reference arm optical path and the sample arm optical path, a detector disposed to produce an output signal V_D representing the optical signal intensity I_D of the optical signals returning from the reference mirror and the test sample and a filter coupled to the detector for separating, from the output signal V_D, a low-frequency component V_L representing a scanning laser ophthalmoscope-like (SLO-like) image pixel, the computer program product comprising:

a recording medium;

means recorded on the recording medium for directing the OCT system to store at least one value V_H representing a two-dimensional (2D) OCT *en face* image pixel and store at least one value V_L representing a 2D SLO-like image pixel; and

means recorded on the recording medium for directing the OCT system to remove a motion artifact from 2D OCT *en face* image data in accordance with the corresponding SLO-like image data.